

# ICI

magazine

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# ICI

## magazine

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### Cover

At his theodolite, 500 feet down in Winsford Rock Salt Mine, stands surveyor's assistant Ron Lightfoot. A miner for 12 years, he took up this job after passing his GCE 'O' Level in surveying. Here he plots a guide-line to control the direction and slope of an excavation.  
Photograph: John Chillingworth

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# MINING FOR SALT



At this time of year the rock salt lorry can be a familiar sight along the roads of Britain – as familiar as the sight of ‘Betrox’ fertilizer (based on rock salt) in a sugar beet field. There are heavy demands for rock salt from local government authorities all over the country as the cheapest, most effective way of clearing ice and snow from roads. By forming brine with the ice or snow it lowers the freezing point, so that roads which would otherwise freeze over can stay open for traffic.

Very few people in Britain (and not all that many in ICI) realise where all this rock salt comes from and how it is mined. To most of us the words ‘salt mine’ conjure up vague impressions of Siberia and political prisoners. The reality is very different. Mond Division’s Winsford salt mine, extending below the rolling green fields of Cheshire to an average depth of 500 ft., is full of surprises. A world apart – in scale, in space,

## CUT . . .

In the early days of salt mining lumps were hewn out from the face by hand after firing single holes with black powder. The process was slow and laborious. Now, with the Anderson Boyes mobile cutter, undercutting of the 65 ft. wide working face can be completed by one man in 7 hours to produce on blasting 1,000 tons of rock salt. Brian Bradshaw, seen at work on the face with the cutter, has operated this equipment for one year. He can also do three other jobs in the mine.

## DRILL...

Forty years in the salt industry, Walter Dean joined the mine from the old open pan works 12 years ago. 'I have been on the old type of drill for several years, and when they introduced this new type of drill I was one of the first to be trained to operate it. For anyone with a knowledge of drilling it was pretty easy to pick up. You've got to concentrate on getting the "angled" holes and the side holes right, and the other holes straight and correctly spaced. If the drilling is not done accurately you get lumps which are too big when the face is blasted.' It takes about 40 seconds to drill a 10 ft. hole, and all movements are controlled by an electro-hydraulic system. Far left, assembling the drill, are Ken Newall and Jack Hornby.

in light, in working conditions – from the conventional idea, say, of coal mining, it has much more in common with the techniques of mass production on the surface in a large modern works.

First of all, standard methods and standard equipment are much easier to use in rock salt because you can work on a bigger scale, with greater thickness than in other mineral workings. With fine wide haulage roads cut out from the rock, all forms of communication are easier. People can be carried about quickly wherever they are needed, and the miners in fact do very little walking, all of which saves time and keeps up production.

How and why did this all come about? And what is it like to work in the only working salt mine in modern Britain, now that even bigger and better equipment for winning, loading and carrying the rock salt has been introduced? About six years ago there was a technical revolution in the mine, when almost total mechanisation was introduced. This revolution has steadily continued, employing mobile cutting and drilling equipment on an ever-growing scale, and taking full advantage of the forced ventilation system which makes it possible to use heavy diesel loaders and dumpers underground. The speed and scale of operations have thus been multiplied many times over. With modern crushing equipment below ground and above to complete the pattern, it is not surprising that the figure of 1 million tons raised a year was recently attained and that the rate today is even higher – 1.3 million. At one time the great aim was to achieve 300,000 tons a year.

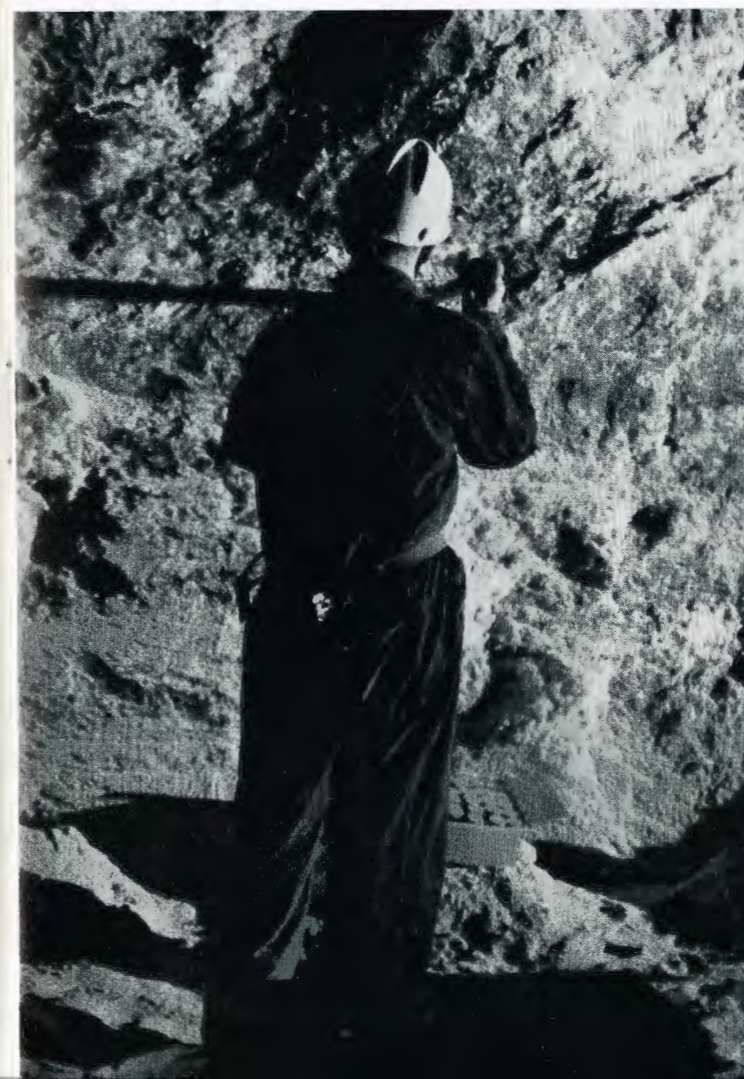
The men themselves have proved remarkably adaptable in the handling and maintenance of machinery. Men in their

fifties, for example, who had used sledge hammers and handled lumps of rock have rapidly become competent and versatile operators: each man in the mine can do at least two jobs, and many can do more. The result is a process as much as possible like a factory underground, using the same kind of tools, equipment and transport one would expect on the surface. There is a fully-equipped workshop down the mine where all equipment is assembled and serviced throughout its entire working life.

Our pictures show the main stages in winning the rock salt: cutting, drilling, blasting, scaling, loading and crushing. They show too the strangeness, the space, the scale of the subterranean setting where the miner is as productive – or more so – than many a worker above the ground.

## BLAST...

Right, Ken Latham inserts a charge into the drill-hole. James Perrin, shotfirer, far right, has recently completed 50 years' service, can remember the time in the mine when 'you did the job with a straw filled with the black powder – that is all you used to set off the shots with. You put it in the hole and lit it with a candle... many's the time I have had to run away. Of course, things down at the face are very different now. For one thing, when I first started you worked with your shirt off – it was very hot down below. Now you can work with overalls on and not feel the difference in temperature. It's the ventilation.' Nowadays he detonates the charge with the Marston electric exploder, which fires 200 holes at a time.



### SCALE ...

Scalers are the men who make the roof safe by removing any loose pieces of rock with pneumatic picks. They move in after the noise of blasting has died down and make the roof safe before loading-out operations begin. After loading-out the scalers return to carry out a yet more detailed inspection. The scalers work in threes from a mobile hydraulic platform positioned by one of the men who acts as the driver. The movement of the platform itself is controlled by the two scalers on the platform: seen here, Ron Walker and Sam Slack. Far down the long tunnel-ways comes the sound of pneumatic picks and the crash of loose rock falling down to the floor.

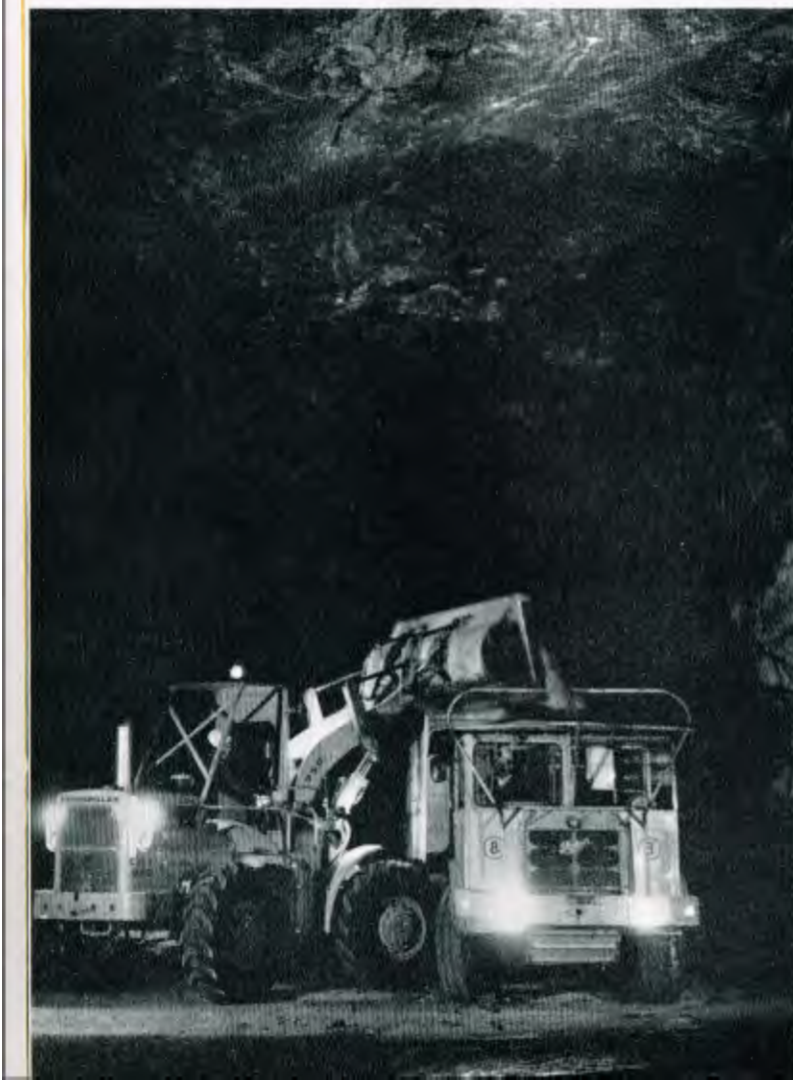
### LOAD ...

Until forced ventilation was installed no diesel-powered equipment could be used underground. Now there are two  $3\frac{1}{2}$  cu. yd. diesel front-end bucket loaders which load all the rock blasted down at the face into a fleet of 20-ton diesel-powered dumpers working in shifts throughout the day. In charge of this bucket loader is Keith Gregory, while Reg Edwards drives the power loader. Between them these vehicles can move up to 4,000 tons of rock salt to the crusher in a working day. Every few minutes on the wide, well-lit motorways below the plains of Cheshire there comes the blaze of headlights and the roar of 200 h.p. engines as the dumpers pass to and fro between the working rock faces and the crusher. Light and dark, noise and quiet, ebb and flow through the long roadways and broad rock chambers of the mine.

### CRUSH ...

The primary crusher can reduce 400 tons of rock salt an hour to lumps of less than 5 in. Operating it, right, is Jim Morgan. From there the conveyors take it on to the aluminium skips, which carry it to the surface in less than a minute. As much as 4,000 tons can be brought up in a single working day. Up there it is crushed and screened for its various commercial uses.

Photographs: John Chillingworth



# The long and the short of it

Graham Hutton

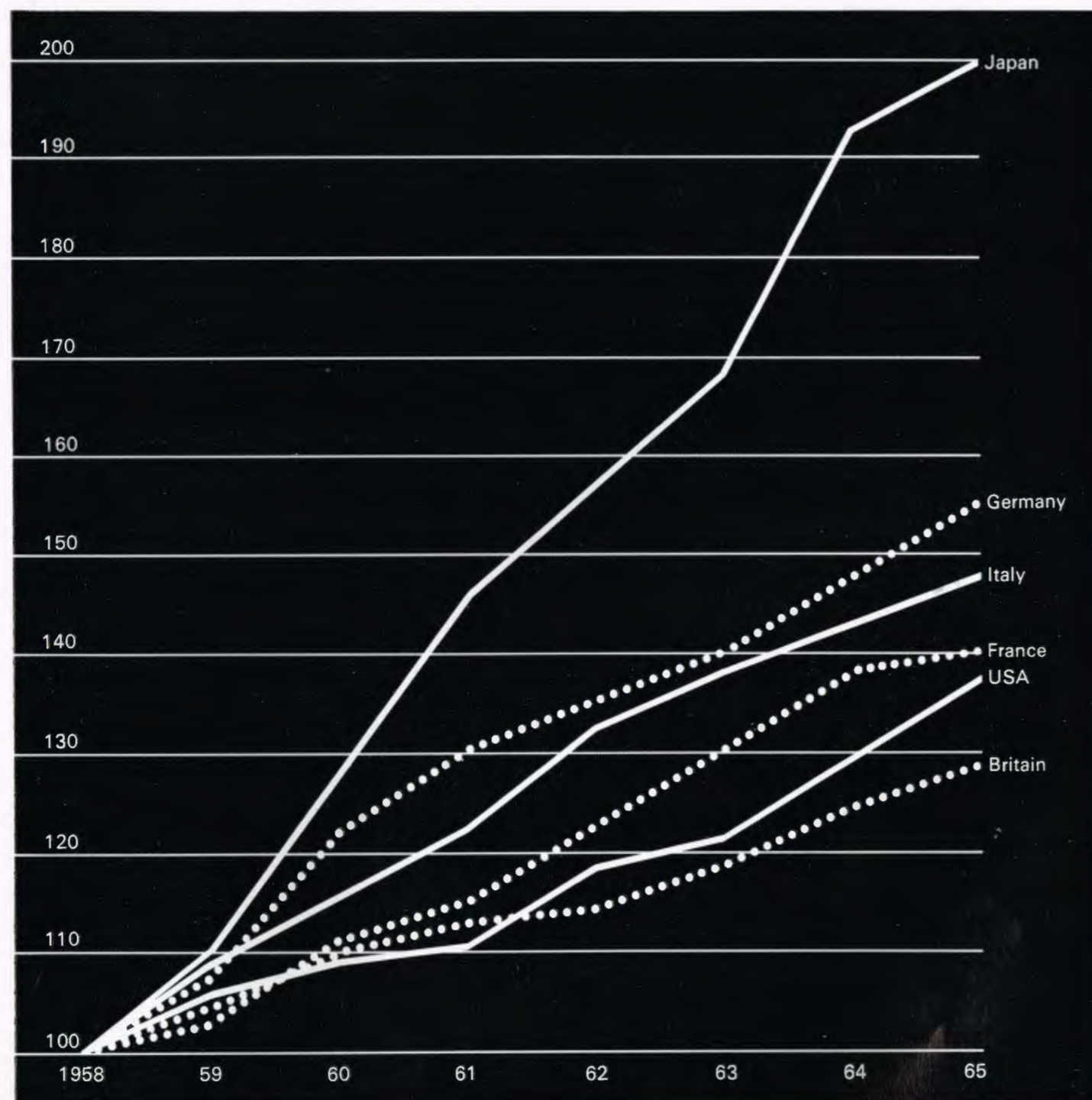


Fig. 1. The Growth League, 1958-65. Index: 1958=100

No topic today is more keenly – or confusingly – debated than Britain's economic standing in an ever-more competitive industrial world. Since the Company's own prospects are so closely linked with those of the country, we have asked the economist Graham Hutton to write occasional articles for the ICI Magazine which single out the underlying facts behind the figures so widely quoted today. He begins with a survey of the basic problems since the war.

Unlike the other Western industrial nations, Britain has had economic hiccups every two or three out of the 21 post-war years. The papers call them 'stop-go' spasms or 'sterling crises.' We have now been over two years in the longest, sharpest and worst of the 'stops.' Moreover, economists at home and abroad cannot yet see how we are to 'go' again without starting up the familiar inflationary run on sterling, and the flood of imports (and relative failure of exports) caused by a domestic full-employment boom pressing against the limits of our existing productive capacity.

To extend these limits we can (a) save and invest (as persons or companies) in more productive apparatus, out of our current income or profits; and (b) improve working practices of our men, managements and machines (e.g. by more shift-work and abolition of the wastes due to over-manning). There are no other ways open. Ideally we should do both.

Fig. 1 tells its own story: Britain bottom of the economic growth league. But before we go into details let us chalk up some credits. We are even now – and long have been – selling in open competition *more than double the quantity* of our pre-war exports, while importing only one-half more than we did pre-war. We have re-created all the overseas investments which we 'popped' to the USA and others during the war in order to finance our war effort.

The big deficits in our annual balances of debits and credits with other countries in the last eight years have been mainly due to Government expenditure (military, civil, and governmental gifts and loans to developing nations) – and *not* to our net travel abroad, consumption of foreign goods at home, or our private or business investments overseas. Our governments have made us shoulder proportionately heavier burdens for defence and aid to 'developing' countries than other governments have put on their peoples. And we are still doing all this governmental overseas spending while cutting down our own citizens' foreign travel allowances and our own firms' ability to invest in profitable ventures overseas.

Our export performance comes from our private enterprises, and it is still pretty good, in *absolute* terms. That means: as world trade goes on expanding, other nations get more of it while we get steadily less of it, hence a smaller share. We steadily export about one-fifth of our industrial production each year, far more than almost every other industrial

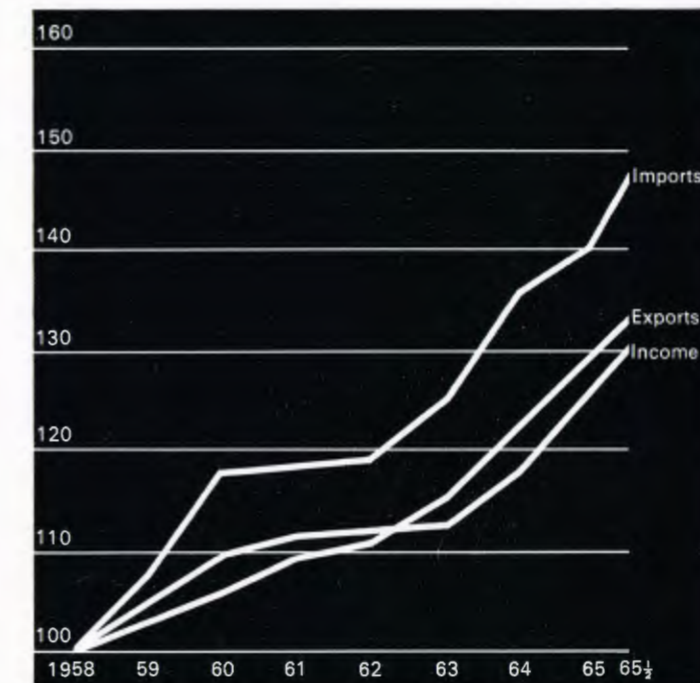


Fig. 2. Britain's Foreign Trade (Volume of Imports of Goods and Services and Volume of Exports) and National Income. 1958=100

nation – and nearly three times the proportion exported by American industries. Indeed, since 1962 (see Fig. 2) we have been pushing up the volume of our exports at a faster rate than our total national income has been growing. Every nation's income is what its people make or raise or render (services), to themselves and foreigners, over and above what they have to buy. The trouble, again, has been (as Fig. 2 shows) that our domestic 'overfull employment' boom, with its problems of 'no more capacity', has forced us to push up imports even faster. Even so, we have clocked-up some impressive export performances (see Fig. 3).

What has made these domestic booms push us up against the limits of manpower and machine-power? On the whole, inefficiencies of managements, of manning per machine-hour and of manning in general, i.e. hours worked per man in the week (unnecessary and costly overtime, for instance). We have invested in quite a lot of the finest modern machines and

## The long and the short of it

methods; but we have continued to over-man them – for instance, using them only half-time or third-time in a week or year compared with our competitors abroad. Even if we doubled our rate of investment in labour-saving and labour-aiding equipment, *but still manned them with old-fashioned work practices and for only a few hours of true machine-time a week*, our total costs per unit turned out would be bound to rise faster and higher than those of our competitors. And when that happens *with fixed exchange rates*, your prices rise faster than others and so you lose export orders.

In Table 1 the story is plain. Over four-fifths of our exports are manufactures. The firms making them – generally big firms, and very few of them – have to face not only this lagging productivity problem (the lower productive efficiency in British industries, both state and private enterprises) but also its inescapable effect on unit-costs.

Fig. 4 shows how, despite rises in output per man-hour, our wage-costs have remorselessly risen over the last two critical years. (They are still rising faster than output per man-hour.) Incidentally, over the same two years, *profitability* – the return on the real value of all capital employed in private enterprises – has been steadily falling. It has been falling in other countries, too. But, *net* of all Government and local taxes, rates, and levies, the flow-back of profits, re-invested in British industry, has been proportionately smaller than in the USA, Germany, Japan, and other industrial countries. So the ability of British industry to offset the remorseless rise in wage-costs

by installing up-to-date labour-saving equipment has been reduced at the same time. New investment has been made. It is still being done. But not to the extent to which other countries' private enterprises can make it. And not to the extent that our own more lagging productive efficiency demands.

Now if you look at Fig. 5 you will see three major causes of our troubles reflected in the graphs: inflated money earnings; lagging output per person employed; and a consequent inflation of the price-level, all of which bedevils our exports and sucks in more and more imports. Hence the Government's various 'squeezes' – on credit, H.P., wage-and-salary-demands, profits, etc. Hence the Government's, and local governments' recent sharp rises in rates, taxes, and National Health and Insurance contributions; and the new Selective Employment Tax, falling on all 'service' occupations and firms. All of these 'squeezes' are aimed to 'shake-out' redundant labour or overmanned machine-capacity, and release it for exports: to lower the excessively high demands made by the home market on our capacity.

What's in store for us in 1967, then? If we raised our over-all productive efficiency, not only of human work, but in the use of all our productive equipment, transport, land, office space and machinery, etc., by only 3 to 4% *and held it*, we would add some £750,000,000 to our total output. In short, by producing *more from the same in-put* of hours of human work, hours of machine-time energy and fuel, raw materials, etc., simply through more efficiency, which is higher over-all productivity, we would be able to repay our recent short-term debts, raise our own real rewards (without price-rises), abolish poverty, build the state and local amenities we would all like to see – and be able to hold our heads high among the nations through worthwhile contributions to defence and aid. This over-all 3 to 4% rise in our productivity means as little as

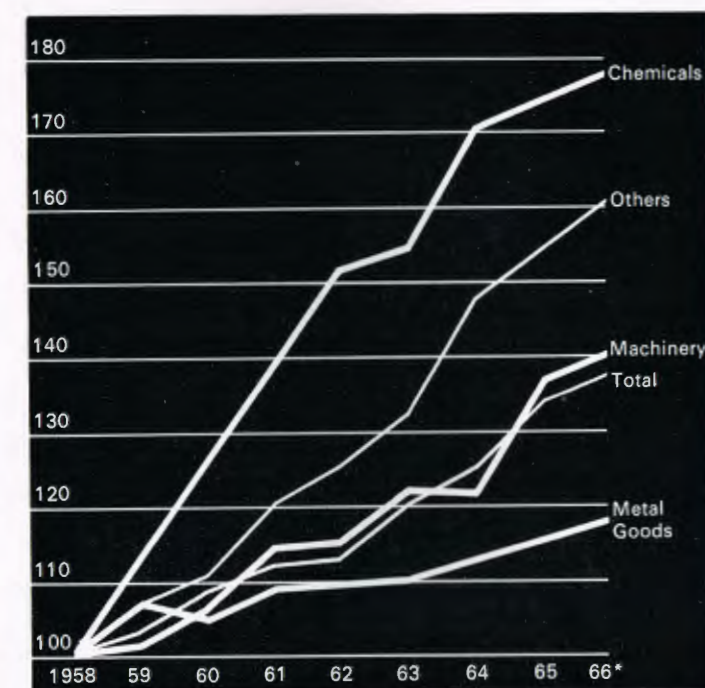
two minutes extra performance per hour from a machine or a man or both together; or that small proportion of wastage of raw materials saved; or that little spoilage of products avoided; or that little amount of fuel or power economised; or that little amount of transport vehicle-time saved; or that little office, sales, or marketing effort economised. Put this way it is a simple problem for us to solve as a nation.

Before the war we ranked third in the world's standard of living stakes. In 1958 we ranked fifth. Today we rank sixth in Table 2. If you add in *all* countries for which we have any figures, we now rank twelfth, out of some 60 countries. We have no great natural resources apart from coal, china clay, and (before long) some natural gas. Our greatest natural, national resources are our people's skills and brains; their abilities to adapt and adopt; their initiative and enterprise; their sense of responsibility, teamwork, and loyalty; their willingness to take, and also to follow, the lead.

The problem before all of us in 1967 – Government, administrative offices, state industries, private enterprises, commerce and finance, professions, trade unions, managements – is to deploy the national resources in more productive, more economical, more efficient, more selling ways. Last year wasn't our 'make or break' year. But it was our shake-out year. This year we have to shake-down into new, up-to-date patterns of work, for managements, men and machines, and then to sell the better products abroad.

That means 1967 cannot be another 'go' year, another reflation. It is questionable whether 1968, or any succeeding year, can, or ought, ever to be inflationary. In the light of our economic performance these 21 years past, 1967 ought to be the Year of Changes in response to the Year of Challenges just ended. There is plenty of room for change in Britain's economy. Just look through these tables and diagrams!

Fig. 3. Volume of certain UK Exports of Manufactures. 1958=100 Machinery includes Transport Equipment



\*Estimated

Table 1. Output per Man-hour in Manufacturing in leading Industrial Countries, 1960–66

Year	USA	UK	Italy	Japan	France	W Germany
1960	100	100	100	100	100	100
1961	104	100	107	109	105	104
1962	108	103	119	113	110	109
1963	113	108	126	121	113	115
1964	117	115	138	138	121	126
1965	120	118	151	147	126	129
1966*	125	121	160	160	134	136

\* Estimated on latest available figures

Fig. 4. Output per Man-hour in UK Manufacturing and Wage-costs per Unit of UK Industrial Output. 1960=100

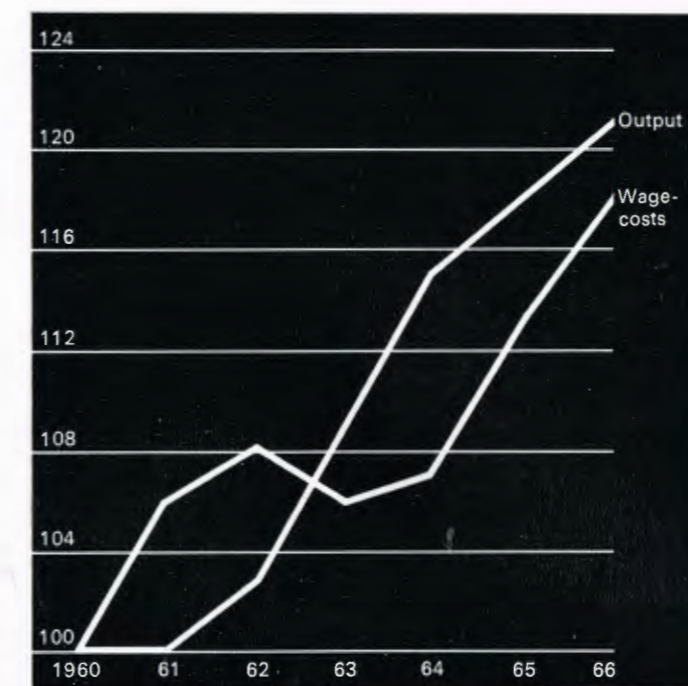
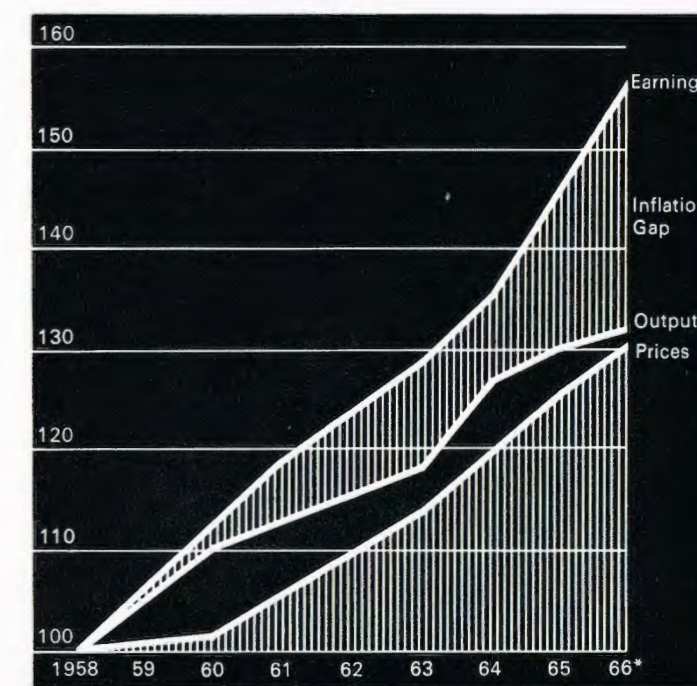


Table 2. National Income per head, 1960–65, according to availability (converted to \$US at official rates and reduced to USA=100)

Country	Index	Country	Index
1 USA	100	10 Italy	29
2 Switzerland	68	11 Ireland	29
3 Sweden	67.5	12 Japan	26
4 W Germany	55.5	13 Portugal	12
5 Australia	54.5	14 Brazil	5.5
6 UK	52	15 India	3
7 Belgium	50.5	16 China	2.75
8 France	50	17 Indonesia	2
9 USSR	35		

Note. The less industrialised the country, the less money plays a role; so there is more *real* income per head in the under-developed countries, arising from self-raised food or payments-in-kind.

Fig. 5. Weekly Earnings and Output per Person Employed in all UK Industries, and Retail Prices. 1958=100



\*Estimated

# Lie still, I'm a first aider!

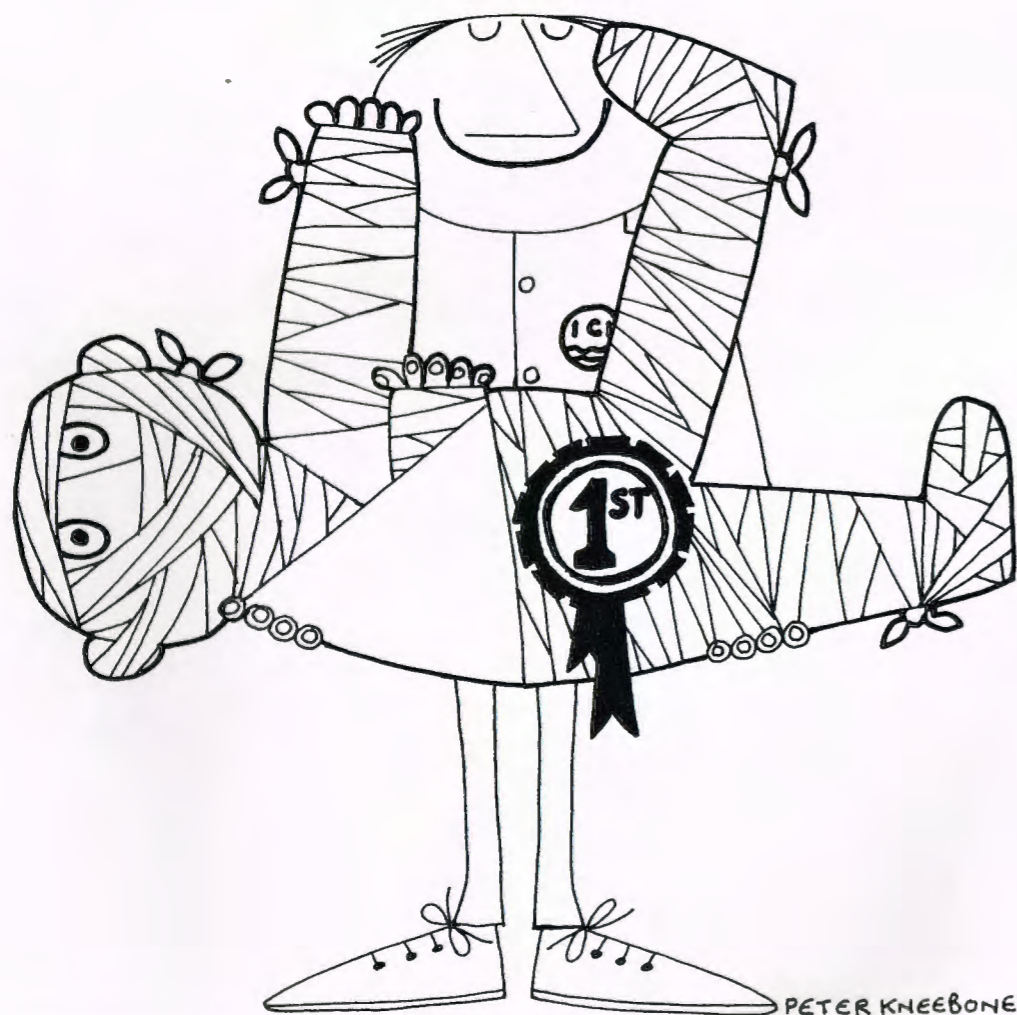
Peter Chivers

Have you ever seen a real accident in which first aiders have been in action, either on the road, football pitch or car track? No doubt you thought how quickly and effectively they did their job and what confidence they gave both the onlookers and the patient. Later, you may have felt, as a helpless bystander, that you ought to try and learn this skill. The first aid organisations would advise a course of lectures, practicals and then an examination, but that would only be the beginning if your ambition is to be a star performer like so many ambulance men.

Actually, the really competent first aider has not been through one examination, but probably dozens. The easiest is the initial one, the rest known as first aid competitions are very much harder.

Real accidents are often child's play compared with the tough challenge of the competition world. Here the first aider is not gazed on by apprehensive, admiring onlookers, but by his critics and very often by his family and even his boss. No wonder therefore that there is fierce rivalry amongst first aiders to do well in competitions.

To be at the start of a first aid competition is rather like attending a mixture of amateur dramatic dress rehearsal and nightmare Emergency Ward 10. There is a flurry of organisers anxious to make sure the timing shall be faultless. The



casualties, looking uniformly like death slightly warmed up, with macabre realistic injuries, are being briefed by the examining doctors. The competitors are locked in a room somewhere – 'in isolation' is the official term. There must never be a risk of prior knowledge of the tests. Although well-treated, these 'first aid prisoners' are also under a great strain for they may have to stay 'in isolation' for almost the whole day. Many swot the 'Book'. This is really the first aid bible.

The first few minutes of a competition can be exciting. You may not realise that this team to be judged may be setting the scene for all subsequent teams, since the performance of the casualty and the props (e.g. the hissing gas tap) will thereafter have to be the same for the rest of the competition. Most enlightened competition organisers insist on a 'run through' to obviate any mishap when the first team enters.

When you in the audience see the first aider approach the casualty and hear him perhaps call out 'Lie still, I'm a first aider!' you will wonder what points the doctor is looking for. Though there is chaos everywhere a competitor should be cool, calm and collected. There is always a mental mark for the gentle but firm competitor who weighs up the situation and takes his time (unless of course there is severe bleeding or the patient is obviously not breathing). Having made sure that there are no emergencies and satisfied himself that neither he nor his patient are in danger, he will proceed to establish what has happened and what is the diagnosis. Much of the verbal interchange will be missed by even the closest observer but the doctor will be listening to everything the first aider says. Thus the pale face, sweaty brow in shock are mentioned and the patient's signs and symptoms are demonstrated to the doctor. The essence of the examination is a combination of wise questioning with a light touch. Although this is a competition the 'patient' is feeling all that is happening and is trained to show displeasure when handled roughly. Moans or screams from the 'casualty' during examination or treatment are obviously debit points!

Speed and gentleness in treatment are two opposing forces in first aid competitions and unfortunately the marking sheets do expect the first aider to complete his test in the allotted time. The audience will applaud a competitor who finishes his test on time. Such applause should be qualified with restraint if gentleness has been sacrificed for speed.

Thus although the marking sheet used by the doctor may be very detailed it is usually possible to detect the good and bad competitors. The too quiet ones and the flamboyant, the obsequious and the comedians are rightly assessed by the knowing audience. If the patient is also a humorist and has a minor injury there can be some very amusing exchanges which recall the dialogue of a comic opera.

Occasionally a stroke of genius leaves the doctor completely nonplussed. Such an occasion was when a casualty was gently squeezing a polythene bottle containing artificial blood in his trouser pocket. To this bottle was attached a plastic tube ending near his ruptured 'varicose vein.' The right treatment for this condition is to lie the patient down and elevate the leg. However, one bright first aider dashed up to the startled casualty and with a quick tug pulled his hand out of his pocket. His triumphant cry of 'Have I stopped the



bleeding?' almost brought the house down! Then there is the competitor who not only knows his first aid but also the judge. He is rather a fine performer who has great confidence and resource. This star will say the things the doctor wants to hear. These are derived from careful perusal of old marking sheets. Without doubt such competitors deserve to do well for they have a dedicated attitude to the 'profession.'

Most doctors have not only learned the book but have had a considerable experience of examining first aiders in St. John Ambulance examinations and small competitions before entering the higher flights.

A competition is a very detailed examination of a first aider's knowledge and practical application of that knowledge and is quite different from the doctor's medical practice. There are few more disturbing experiences for a doctor than to have to face a critical audience of first aiders who have devised a test for him with a prominent first aider as judge. A doctor handling an accident in real life, or for that matter a first aider so doing, would not always score highly if he acted similarly in a competition. Perhaps all doctors ought to go through this cathartic experience. It certainly gives one a new insight into first aid competitions and makes one tolerant of the many stupid things that happen as a result of nerves. It also shows how very important observation and communication of findings are to good scoring.

All the big companies think highly of first aid competitions for the benefit of their accident treatment organisation. The man, or woman for that matter, who has done well in competitions will do well in the real world of accidents, for the treatment of the real, as opposed to the simulated, injury in real life is usually much easier than in a competition.

Anyone who has gone to a car race meeting, football match or seen the results of a mine accident will have realised the work that experienced first aiders do. Without the benefit of competitions much of their practical finesse would be lost.

# Two miles a leg

Margaret Reekie

Eight out of ten of that familiar line of backs besieging the weekend bar now wear pullovers or sweater shirts instead of tweed jackets. They arrive by car, and the extra degree of stretch in the knitted garment gives easier movement in the driving seat. Women, too, like the flexible comfort of a jersey suit, while children love the jersey trews and leotards in which they can run, kick, play – and stretch – as much as they like.

Who could have imagined all this twenty years ago, on 3rd February 1947, when listeners to the BBC's 8 a.m. news heard that people had been queueing since daybreak for nylon stockings, to be released that day? The growth of synthetic fibres dates back to that first British-made consignment of what were then called 'no-seam' or 'bare-leg' nylons.

Those nylons, now regarded as suitable for housework, made in 30 denier yarn, were hailed as textile miracles at the time; 30 denier nylons are finer than the sheerest silk stockings. Today, only about 10% of women's stockings are made in heavier deniers; the other 90% are 20 or 15 denier, approximately three times finer than a human hair.

This 'miracle fibre' reception for nylon brought its problems. Originally it was reckoned that a pair of stockings took three and a half miles of nylon yarn. With today's mini-skirts, four miles would be a reasonable estimate. And it now takes just one minute and 40 seconds to knit a seamless nylon stocking compared with 14 minutes in 1947. Post-war shortages, while the first peacetime factory for producing nylon yarn was under construction at Pontypool, aroused extremely vocal resentment. A pair of nylons had become a vital success symbol. Pressure groups demanded priority supplies: during 1950 there were twenty-two questions in the House concerning nylon, and in February of that year members of all three political parties offered the electorate more nylon stockings.

Various fantasy stories were widely circulated. One of the most tiresome was The Curse of the Parachute or The Great Porosity Fallacy: 'Nylon is cold; it isn't healthy; it's non-porous.' Like most prejudices, this had some connection with fact. Surplus nylon parachute cloth had emerged after the war like bounty on a coupon-ridden market. Manufacturers, at that time unshackled by brand name regulations, seized upon

Glitter stockings are the knitting interest here: the chiffon dresses in Bri-Nylon are designed by Louis Feraud



this lightweight white cloth for shirts and nightdresses. But a parachute cloth is woven for one sole purpose; to bring an airman safely down to earth. To achieve this, it is designed as a close-woven taffeta-type fabric with low porosity.

This fabric is quite unsuitable to be worn next to the skin and the cold, clammy results haunted nylon development for some time. It took warp-knit nylon, first in women's underwear and later in men's shirts, to convince the public that this 'porosity' is achieved by the construction of a fabric rather than by the yarn used. Since knitted fabrics are essentially porous because they consist of holes surrounded by loops they won this battle, as nylon's rising share of the shirt market from 7% in 1960 to 35% in 1965 testifies.

The swing to knitted fabrics and garments is one of the most notable features of textile development over the past twenty years. The weaver, still extremely important, is now rivalled by the machine knitters. With machine-knitted dresses and suits, jackets and trousers, shirts and socks, underwear and ties, all widely available, the modern man, woman or child can easily be dressed from head to toe in garments made from knitted synthetic fibres. Twenty per cent of all garments hand-knitted in the UK are now also knitted in nylon, but that is another category.

Growth figures are dramatic. In 1956, the total UK sales of knitted goods was valued at £207m. By 1965, this value had increased by well over 50% to £323m. These figures include

Paris fashion in 'Crimplene': fabric and dress by Capucci



fabrics shows how a genuinely easy-care synthetic fibre can create a new market. In 1956, there was virtually no synthetic jersey fabric on the market. Out of a total sales figure of 13m. lb., the synthetic share was .05m. lb. By 1965 synthetic fibres had shot up to 18m. lb., more than half the 32m. lb. total. Of these, 'Crimplene' grew more than any other, accounting for something like 30% of the whole double-jersey trade within less than three years. Cotton and other man-made fibres had fallen back but wool's share had also increased so the 'Crimplene' contribution was mainly new jersey business. Ten years ago, when nearly all the double-jersey used for women's suits and dresses was in wool which had to be dry-cleaned, the trade was confined largely to autumn and winter

made-up garments, both outerwear and underwear, socks and stockings, warp-knit fabrics of the kind used for Bri-Nylon shirts and other knitted fabrics but not the sales of warp-knit fabric produced in the lace industry. Usually known as Raschel laces, these fabrics are now used for the popular crochet-look dresses and casuals as well as for lingerie. In 1965, their sales were worth approximately £5.5m.

The significance of this expansion for ICI Fibres Ltd. as a major synthetic fibre producer can be seen from a survey of the UK knitting trade's yarn consumption, analysed by fibre, over the past ten years. In 1956, the total intake figure for yarn of UK manufacture was 172m. lb., rising to 222m. lb. by 1965. Of this, synthetic yarns amounted to only 15m. lb. in 1956. Ten years later, consumption of synthetic yarns had risen to over 105m. lb. The term 'synthetic' distinguishes the chemically-based fibres, polyamides such as nylon, polyesters such as 'Terylene' and acrylics such as 'Courtelle,' from other man-made fibres, the viscose or acetate rayons with a vegetable base.

This distinction is important because the knitting trade's intake of these other man-made fibres during this same period fell from nearly 23m. lb. to just under 16m. lb. Comparable figures for wool and wool mixtures showed 80m. lb. in 1956, falling by nearly half to 48m. lb. in 1965. The fall in cotton from 56m. lb. to 51m. lb. was less marked. Synthetic gains show some 54m. lb. won from competitive fibres and around 36m. lb. overall increase in yarn consumption.

The gain in the proportion of synthetic yarns used, compared with other man-made fibres, is particularly marked in the warp-knitting sector of the industry. Warp-knit fabrics first became popular as the fine, smooth materials which made non-shrink, non-iron underwear for women. The industry then branched out rapidly into shirts, sheets, blouses and dresses, in either smooth or brushed-surfaced forms of the fabrics. Now, these fabrics are entering new growth areas as surface cloths for lightweight laminates – foambacks and other bonded fabrics – and as upholstery materials. In 1956, nylon accounted for no more than 25% of man-made fibres used in the warp-knitting industry, a total of just under 18m. lb. Demand has completely swung round and the nylon proportion is currently running at 70%, with total 1965 deliveries amounting to over 50m. lb.

The dramatic success story of 'Crimplene' knitted jersey

Bri-Nylon dress in black and cinnamon by Celli Avon of Milan



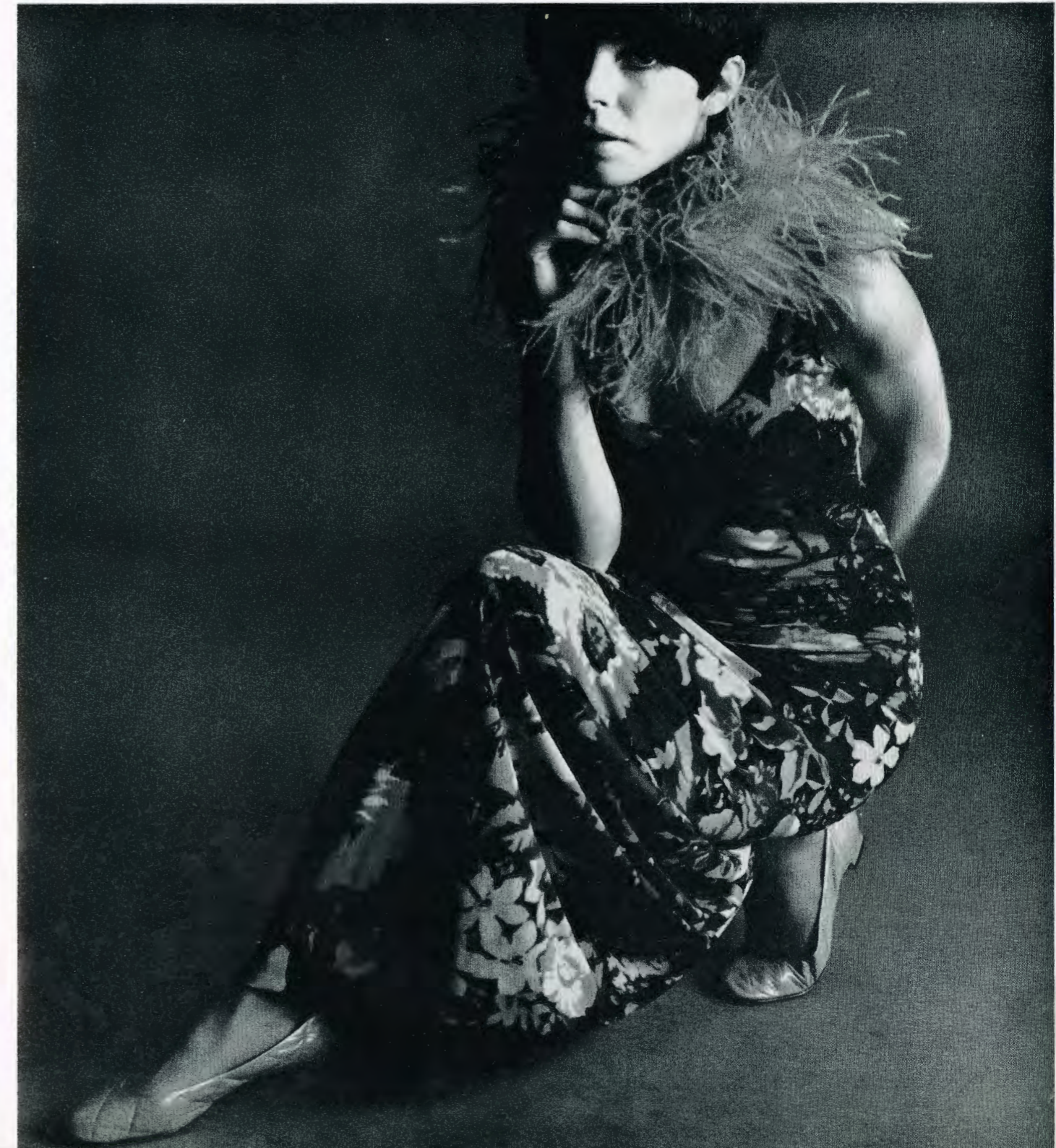
and to the sensible colours and dull styles which fashion writers despairingly refer to as classics.

Acrylic fibres introduced jersey fabrics in light colours designed for spring and summer – but the wash-and-wear qualities of these garments did not come up to public expectations. 'Crimplene' changed all that. Here was a hard-wearing jersey which really could be washed without shrinking or stretching. This success story continues: a wide variety of weights and textures now covers the complete range of women's outerwear fashions, and newly-developed 'Crimplene' jerseys are becoming popular for men's and children's wear.

Why this swing towards knitwear? Probably a combination of increased fashion-consciousness and the demand for com-

fort. In the competition to produce clothing attractive enough to entice spare money out of people's pockets, knitted goods start with the great advantage that knitwear machines work so rapidly. New fashion ideas can be translated into commercial fabrics almost within days. The big rise in the number of young people following the sharp increase in the birthrate just after the last war, has created a comparatively affluent group of customers, highly fashion-conscious, enjoying plenty of leisure and ready to buy whatever takes their fancy. The knitwear industry is bringing them the up-to-the-minute and comfortable clothes they want.

'Ban-Lon' Bri-Nylon jersey in a flower print. 'Ban-Lon' is a process for bulking nylon yarn. Evening dress by Frank Usher



# The chemistry of 'stuff'

John Wren-Lewis

Modern plastics, synthetic rubbers, synthetic fibres and paints represent a double revolution. They show that it is possible to go far beyond what nature provides in the way of substances for making fabrics, for constructing all kinds of solid objects, or for coating surfaces. With such new 'stuff' we can already make things that were practically impossible before (from drip-dry fabrics and non-stick saucepans to light waterproof transparent coverings of vast size), and can put into the hands of vast numbers of ordinary people luxury objects such as carpets or complicated toys which in earlier generations only a very few could have had. The future holds prospects of still newer materials, and hence of still greater human creative potential.

But this practical revolution has become possible only because chemical science underwent a *mental* revolution in the years between the two world wars. Structural substances had proved completely baffling to the chemist, in spite of enormous progress in analysing – and synthesising – extremely complicated materials such as dyes and drugs. Rubber, gum, wood, cotton, wool and skin were found to involve compounds (of carbon, hydrogen, oxygen and nitrogen for the most part) which were more than just complicated: it seemed impossible to allocate any proper chemical formulae like  $H_2O$  or  $H_2SO_4$  to them, because different specimens seemed to have different compositions.

Attempts to use chemistry in the invention of new structural materials were made as far back as the 1850s but they had relatively little success, because there was no real understanding of what kind of material to make. These early efforts were inspired by an accidental discovery made in one of the oldest of all branches of chemical craft, the manufacture of explosives, which had been carried out on a fairly systematic basis ever since the discovery in the West of gunpowder, in the thirteenth century (by Franciscan friars, it is believed!).

The chemical investigations of the first half of the nineteenth century showed that gunpowder owed its explosive character to the large amount of oxygen in nitrates such as saltpetre. A Swiss chemist, Schönbein, used this discovery

Vinyl chloride was seen to form a resin in 1835 but the science needed to make PVC was not developed until 1928. A modern use is for pressure piping seen here in an ICI laboratory



Pressure-testing fishing floats made of 'Alkathene', ICI's brand of polythene. Simplest of plastics in structure, polythene was discovered in ICI's Winnington laboratories in 1933

in 1845 to invent a new explosive by treating cotton waste with nitric acid. During his work he noticed that his material (later manufactured in England under the name of guncotton) passed through a stage of being 'plastic', so that it could be moulded into various shapes and then allowed to set into solid objects, firm but very light. This discovery was taken up in the 1860s by a Birmingham metallurgist and rubber expert, Alexander Parkes, who varied the nitration process to produce a non-explosive material which instantly excited wide public interest – the material we now call celluloid. Even more interest was generated when it became clear, in the 1880s and 1890s, that the 'plastic' material, known chemically as nitrocellulose, could be used for making varnishes and could be spun out into a fibrous substance, an 'artificial silk' many times cheaper than real silk.

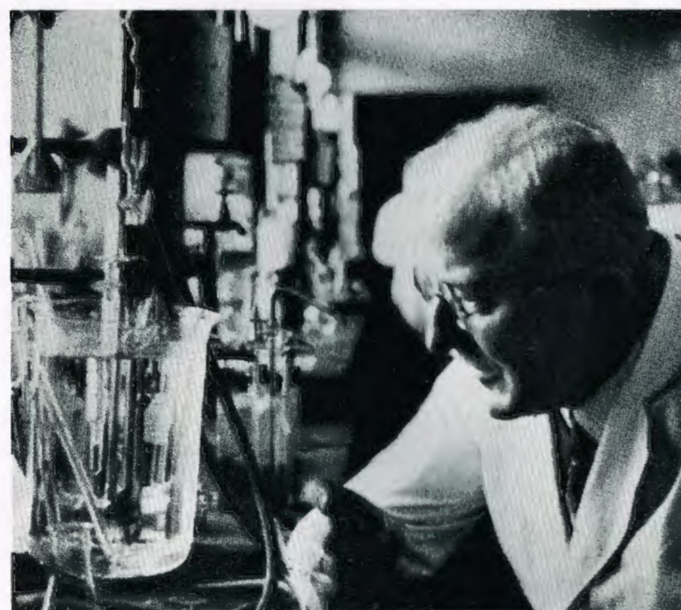
However, these products had the enormous drawback of being highly inflammable, for they were still near relatives of

gun-cotton. This gave added incentive to the search for new inventions in the field, which had already been inspired by Parkes' proclamation that a new era in materials had dawned. The first inventions were, like nitrocellulose itself, only semi-synthetic materials, in that they were obtained by applying chemical treatments to a natural structural substance; in particular, ways were found to plasticise the cellulose of cotton waste (and later of wood pulp) without nitrating it,



Alexander Parkes (1813–1890)

Herman Staudinger (1881–1965)



and these gave the world viscose rayon, cellophane and acetate rayon ('Celanese') in the first decade of this century.

Other chemists took a more radical approach, by experimenting with various resinous deposits which formed when certain liquid chemicals were mixed or heated together. The most conspicuous success here was with phenol and formaldehyde, two relatively cheap products of the coal-tar industry, and in 1907 a Belgian named Leo Bakeland, working in America, patented an industrial-scale process for making the phenol-formaldehyde resin which he called 'Bakelite'. This was the first wholly synthetic structural material.

Unfortunately, these new artificial materials were no easier to understand than the natural ones, and it seemed as if progress would be an entirely hit-and-miss affair. It was



Moulded plaque, an early article made from 'Parkesine'

particularly galling that one of the commonest natural 'plastic' substances, rubber, seemed as if it ought to be simple to synthesise from coal tar products, since its composition was found to be closely similar to that of the simple hydrocarbon isoprene,  $C_5H_8$ , a liquid originally discovered by decomposing rubber itself with gentle heat. The precise connection between isoprene and rubber remained baffling, however: although a resinous deposit could be made by heating isoprene under pressure, it was nothing like rubber.

It seemed certain that rubber was a complicated compound in which several molecules (i.e. the smallest possible units) of isoprene were joined up in some way to form larger units, a principle recognised in the middle of the nineteenth century by Berzelius, who had a gift for coining terminology and had invented the term *polymer* to describe a compound whose formula happened to be an exact multiple of the formula of some simpler compound. Thus the hydrocarbons butene,  $C_4H_8$ , and hexene  $C_6H_{12}$ , have formulae which are exact

multiples of the formula of ethylene,  $C_2H_4$ . Some instances were known of materials which actually turned into polymers of themselves on heating – for example, acetaldehyde, which can turn into a solid compound called paraldehyde, in each molecule of which three acetaldehyde units are joined in a ring, as shown in Fig. 1.

Yet rubber was clearly no ordinary polymer of isoprene, for it was nothing at all like the hydrocarbon oils known as terpenes which can be extracted from plants, and these were known, well before the turn of the century, to be 'double isoprenes' – complex structures with basic formula  $C_{10}H_{16}$  whose relationship to isoprene was somewhat similar to that of paraldehyde to acetaldehyde.

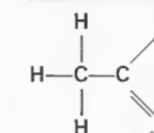
Chemists naturally considered the possibility that rubber might have molecules with more than two isoprene units in each, but when they made tests of rubber solutions to try to estimate just how big the rubber molecules were, they came up against a conclusion from which most of them shied away in horror. It seemed as if the molecules of rubber were *many hundreds or thousands of times the size of isoprene units*, and, what was worse, that *not all molecules were the same size*.

This seemed to go against everything chemists had fought to hold on to since John Dalton and his contemporaries first established chemistry as a science instead of a semi-mystical study a century or so earlier. The definite formula with a definite number of atoms in each molecule had become almost sacrosanct, and to go back on it seemed like opening the floodgates to chaos. Of the pioneers who overcame this prejudice and showed the way forward, a very substantial share of the credit must go to one man, Hermann Staudinger, who was inspired by the limited success of German industry during the blockade conditions of the 1914–18 war in making very poor but still serviceable artificial rubbers from a near-relative of isoprene.

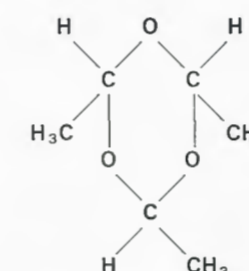
He started working on the problem of the nature of rubbers and resins in Zurich in 1920, and in 1926 moved to the University of Freiburg where he remained a professor until he retired at the age of 70 in 1951. By that time he was being hailed as the founder of something like a whole new science – the science of 'high polymers'. (He received the Nobel Prize for his work in 1953.) But in the years between 1920 and 1928, when he was trying to establish the idea of polymers with molecules containing hundreds or thousands of basic units, he met with criticism amounting often to ridicule. Only by meticulously amassing evidence from many quarters did he manage to convince people, and so open the gates, not to chaos, but to new discovery and a new era of technology which has gone far beyond the dreams even of Alexander Parkes.

Staudinger's idea was that the kind of polymerisation that takes place when acetaldehyde turns into paraldehyde can, with some substances, be vastly extended so that molecules are produced which are in effect long chains, with many hundreds or thousands of carbon atoms in the backbone of the chain (Fig. 2), or two-dimensional mats (also shown in Fig. 2) with networks of chemical bonds spreading over even larger areas. Chain-molecules of the size here envisaged would, if stretched out, be of the same kind of length as a layer of gold leaf is thick, but in general they tend to curl up,

Figure 1

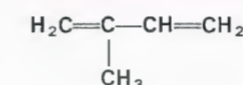


Acetaldehyde, more commonly written  $CH_3CHO$ , was one of the earliest substances to be observed turning into a polymer of itself. Three molecules of acetaldehyde would combine together to form one molecule of a new substance, paraldehyde, with the ring structure



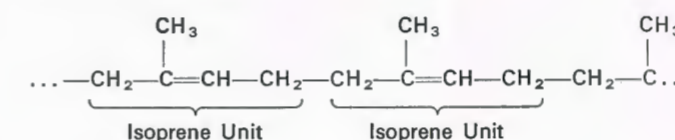
The group  $CH_3$  is a very common one in organic chemistry and is called the methyl group.

Figure 2

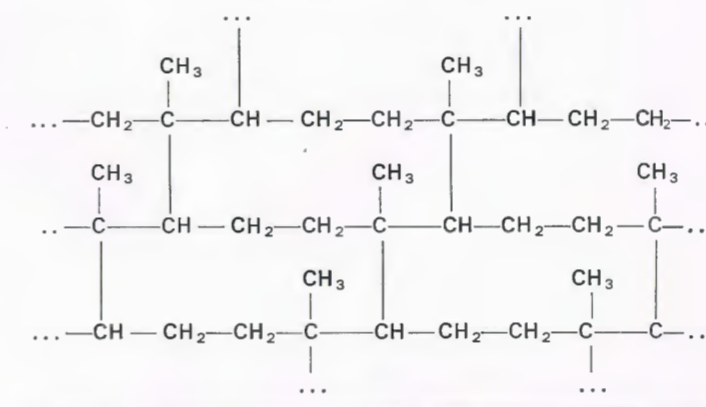


Isoprene, the hydrocarbon with formula  $C_5H_8$  obtained by gently heating rubber.

Although the secret of turning isoprene into a respectable rubber was not discovered until the 1950s, Hermann Staudinger realised in the 1920's that its molecules were composed of hundreds of isoprene molecules joined together in long chains



Some polymers form not just chains, but two-dimensional networks, and sometimes a chain-polymer can actually be turned into a network one under suitable conditions. This is the process known as cross-linking, which is used to turn a malleable polymer into a hard, rigid solid or film. This is what happens when paint sets or when rubber is vulcanised, and a rough idea of the result in the latter case is given by the (very much simplified) diagram below:



which means that a mass of such molecules form an intertwined tangle and so make a structural material with a good deal of flexibility; while a two- or three-dimensional network constitutes a very rigid structure, either as a film on a surface or as a solid mass.

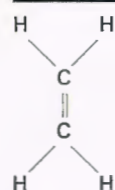
The full details of the relationship between the physical properties of structural materials and the inner chemical structure of the 'giant molecules' composing them were not worked out for many years after Staudinger's original insight, and indeed a great deal still remains to be elucidated even today. Much research in several of ICI's laboratories is concerned with this. But Staudinger laid the essential foundation, and he also saw that the clue to making high polymers with giant molecules is to start with a chemical whose molecules can react in at least two ways at once.

In the case of hydrocarbons like isoprene, the clue is the presence of 'double bonds' between certain of the carbon atoms. A carbon atom has four 'links' with which it can hold on to other atoms, and the vast complexity and variety of carbon chemistry ('organic' chemistry) is due to the fact that carbon atoms have a tendency, not shown to the same degree by any other element, to 'link hands' with each other in chains or rings while still holding on to other atoms with the valency links that remain. In compounds like isoprene, however, some of the carbon atoms hold each other with *two* of their valency links, not just one, and such a 'double bond' has long been known to imply a special sort of chemical reactivity – a tendency to pick up pairs of chlorine or hydrogen atoms, for instance (Fig. 3). What Staudinger saw was that it could also imply a tendency for molecules of a substance containing double bonds to join on to each other and to go on doing so to form vast chains or networks until something happens to bring the process to a stop. All that is needed to start the process is to inject energy to 'open up' the double bond, and this can be done by applying heat or light or pressure, or by adding small quantities of suitably energetic chemicals (known as initiators).

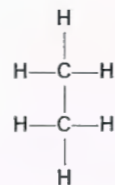
Staudinger vindicated his insight by producing a polymer from the double-bonded hydrocarbon styrene, and the resulting material, polystyrene, is still an important plastic today. In the next decade, leading up to World War II, many similar double-bonded hydrocarbons or derivatives were found to yield valuable polymers, most particularly vinyl chloride (giving PVC) and methyl methacrylate (developed by ICI research workers into the remarkable transparent plastic 'Perspex', the first real 'unbreakable' substitute for glass). An accidental discovery in an ICI laboratory showed how to polymerise the simplest of all double-bonded hydrocarbons, ethylene, to produce polythene. Another accident in an American laboratory led to the discovery of polytetrafluoroethylene, the heat-resistant plastic whose very low-friction surfaces make non-stick articles possible.

The problem of making a respectable rubber from isoprene, however, remained unsolved until the 1950s, by which time the production of polymers had expanded from thousands of tons a year to millions of tons a year. This phase of the story will be the subject of my next article, together with an account of the other quite different chemical reactions that can give rise to polymers, the reactions that have given us nylon and 'Terylene' for fibres, alkyd resins for paints and polyurethanes for foamed plastics. None of these discoveries was possible, however, until chemistry had outgrown its early obsession with definite formulae and molecules containing restricted numbers of atoms, which just goes to show how the great creative ideas of one generation can become prejudices inhibiting progress in the next. Perhaps the major problem of scientific education is to make young scientists aware of this without undermining their confidence.

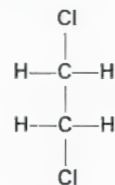
Figure 3



**Ethylene**, (structure above) the simplest of all substances with two carbon atoms joined by double bonds, rather than the normal single bonds, which occur in

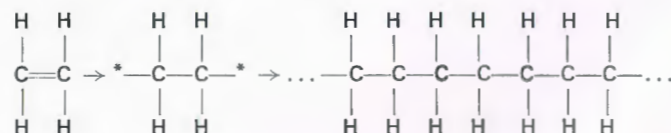


**Ethane**, the corresponding 'saturated' hydrocarbon. The double bond in ethylene implies that it can pick up hydrogen atoms to form ethane, or chlorine to form



#### Ethylene dichloride

The same 'unsaturation' in ethylene makes its molecules able, given some added energy, to 'open up' and join on to each other to form long chains, thus giving polythene:



Very few polythene chains are perfectly straight, however. Most have branches, and the amount of branching is a vital factor in the quality of the polythene.

\* is simply a crude symbol for an 'activated' atom

## Gordon Kenderdine of ICI (Japan)



From left to right: F. Suzuki, Assistant Manager, chemical sales and export; Gordon Kenderdine; D. Koike, a customer

To the stay-at-home Englishman, the phrase 'East of Suez' calls up a confused, kaleidoscopic picture, with images from Kipling, Conrad, Maugham jostling one another as fiercely as the crowds in an Indian or Chinese bazaar: beauty and squalor, sweat and splendour, heat, noise, light, movement. Few of us can hope to get the life, the lands, the people of the Far East into perspective. Just once in a while, one meets an Englishman to whom this world is as familiar as London or Birmingham might be to most of us. How he gets on terms with so alien a world it is hard to say, though the English respect for rituals and their role in social and business life has a lot to do with it.

Gordon Kenderdine, President of ICI (Japan), was born in Japan and has spent a lifetime in the Far East: Indonesia, India, Burma, China, Japan – Japan in particular. Tall, well set-up, forthright, there is little about his outward bearing to suggest that he speaks several Asiatic languages and shows uncommon insight into the manners and customs of countries utterly removed from the country club atmosphere his appearance at first conveys.

A life of change (often sudden) and of opportunity, opened up for him at the age of 16, in the troubled thirties when the Japanese invaded North China. 'My mission school in China was said to be the best school East of Suez. It was extremely

tough, and there was nothing namby-pamby about the missionaries there. I got my Matric. exemption and left for Japan in a hurry just before the Sino-Japanese war engulfed North China. . . . Back in Japan, he was taken on as a junior by the agents for the British Metal Corporation, the Anglo-French Phosphate Company and the British Phosphate Commissioners: 'It was a very small office – but we handled an enormous turnover. The Burma Minerals and Metals Company provided about one-third of the lead in Japan in those days, while we were also agents for Broken Hill, the Electrolytic Zinc Company of Australasia and two major phosphate groups. For all this business there were just the two of us in the office, myself and my boss who did most of the travelling. My training in commerce came on the job: merchanting, chartering and shipping. You had to know a bit of everything. Of course this still applies to a certain extent even today.'

He had hardly been three years in this job when another, bigger war again brought sudden, urgent change. In 1941, acting on hints from the British Consul and from his own Japanese contacts, young Kenderdine left his job as commercial assistant, sailed for India and volunteered for the Army as the rawest of raw recruits: 'India at the time was in a state of near chaos, just before the Japanese attack on Burma. Everything had to be built from inadequate materials

and I was a part of those materials. At last they got me into the semblance of a soldier – I was never a very good one. But forming an army unit from scratch was a very instructive experience. You had to draw up your own establishment scales and equip the unit right through from basic necessities to signposts. One cannot help learning from that kind of exercise. Later on, it helped me a lot when I was sent to Indonesia to open ICI's Surabaya office from scratch. Brought me down to the basics – transport, a roof over your head, pencils, pens, paper and so on, that I'd never had to think about before. It was one of the most useful things I ever did in the Army.'

'Inadequate' material or not, by the end of the war Gordon Kenderdine, at 23, had become a Major in the occupation forces of the Army in Japan. 'I sat down and wondered whether to strike out on my own as an agent or to join a big company.' Finally he approached ICI and was taken on as a trainee in the then Far East Department. A series of educational visits to Divisions followed, including a period with the distribution organisation at Runcorn. 'After that I was told there was a job going in Japan, then that there was a demand for a man in Indonesia (still then the Dutch East Indies). In the end I flew to Singapore, not knowing where I would end up – Japan or Indonesia!' The pattern of movement and sudden change was running true . . .

#### A tough apprenticeship

His first assignment with ICI turned out to be yet another exercise from scratch, with little knowledge and less experience: 'I arrived in Surabaya to find that the accounts were kept on two spikes on the local manager's desk: bills on the left, receipts on the right. Translating this into a proper system with a ledger (carried personally from Singapore) was only one of the things I had to do. The company was just starting up.' Here was a tough apprenticeship. Dutch protectionist attitudes just after their return, Indonesian nationalism, risings, revolts, police actions – such was the background of a market to which ICI were in any event comparative newcomers. Soon after the Indonesians took over their country in 1949, came the slow, relentless build-up of restrictions on business enterprise by foreigners. He was handling a mixed bag of commodities in Surabaya at the time – soda ash, caustic soda, dyestuffs – 'I did a bit of venture trading, bought up a lot of war-time Japanese soda ash in Surabaya and sold it at a profit in West Java. Industry at the time was pretty primitive: we had one textile factory that didn't do any dyeing, a lot of soap-makers, one small paint factory, a couple of glass factories and a big line of dyestuffs for the batik industry. Gradually we had to close down, cutting down at the end quite suddenly from 21 foreign staff to four. . . .'

Not long afterwards the Indonesian economy collapsed and Gordon Kenderdine's job disappeared. However, ICI (Japan)

had a job to offer him, running their dyestuffs organisation – on one very natural condition, of course: 'I had no dyestuffs training. So I did a cram course, covering the bulk of an 18-month course in five months and nearly killing myself in the process! Most exhausting. Then I went over to Japan, took over the dyestuffs organisation and gradually built it up. It then had a staff of five and a turnover of £60,000. Today those figures are 38 and £1.5 million respectively.'

The story of the Japanese operation has been told by Gordon Kenderdine himself in the December 1965 issue of ICI Magazine. The first thing to grasp about business life in the Far East, he insists, is that 'it is quite impossible to force yourself upon a man if he does not at the bottom of his heart and mind accept you. He'll say yes, of course, to get rid of you: but when an oriental businessman says something he doesn't mean, it's usually pretty clear. And don't forget that the written contract is a rarity in the East. I've often been horrified by visiting occidentals who treat a reluctant "Yes" as a firm contract. They try to pin the oriental down and he won't be pinned down. The goods are not going to be delivered because the contract was never there. I'm afraid this springs largely from the inability of the Westerner simply to sit down quietly and listen!'

#### A salesman

A salesman by temperament, Gordon Kenderdine at his present level finds the planning side of sales more fascinating than the actual clinching of a deal. 'What really attracts me now is building up a sales organisation and sales channels, directing the effort where it will get results. And working for a *manufacturing* company like ICI you can't do what the merchanting company does – go all the time for the most profitable lines. You have to look further back to see which product the company must sell and put your effort into that.' He has invested much time and thought on the selection and training of salesmen in a country where until recently the salesman had little or no status or rights: 'For my sales managers the problem has been how far they can adapt European sales training methods to Japanese selling conditions. They have had to compromise, training the Japanese salesman with methods that will work in Japan and dropping the rest. Long-term contracts with quantity rebates are rarely considered by the buyer – essentially it is a question of approach – Japanese resistance to over-aggressive "red-hot" salesmanship is impressive! Of course, Japanese salesmen have changed enormously in the last five years. In place of the routine order-taker of the past, with little real knowledge of the product, you're now getting a sales force of technically-qualified men. This really is revolutionary. They have standing and nowadays they're not talking to some ignorant purchasing manager who happened to know the local president of the firm, but to a fellow-technician who will be handling production in the works. So the whole pattern is changing.'

'We naturally were most interested in the dyestuffs market, and the only man who can sell dyes is a trained technician. On the chemicals side we have salesmen with quite a lot of technical knowledge of various sorts, and a few real experts, but they all know their market. We send our people to



Japan National Tourist Organisation

Divisions for training as required. This policy is paying off. To have one of your men talking to customers about the factory that made the product and having to admit that although the customer has been there twice he himself has not seen the factory simply will not do!'

Senior sales people are also given a background course on how ICI management works, which is not just sales training: it is management training, a problem in which Gordon Kenderdine takes a special interest. 'I have set up a junior executive group with no executive responsibility as such, which meets once a quarter with me in the chair. The agenda at these meetings covers any questions the members may care to ask about the affairs of the Japanese company; the affairs of ICI as a whole; the Japanese/British trading position, and so on. There are only seven people involved and already three are assistant managers of departments.'

The dealer system peculiar to Japan takes some understanding by the businessman trained in the West. No manufacturer in Japan sells his own goods direct, either at home or abroad. He always works through a trading auxiliary or dealer – and the dealer in Japan is very powerful indeed. With small manufacturers they are all-powerful, mainly because they are linked with the banks who advance money on goods to be manufactured. In general these big semi-independent trading houses take off the shoulders of local management the whole responsibility for distribution and sales.

'In our own operations' he explains, 'you've got to decide when to market, whom to sell to, and above all to choose a suitable dealer, preferably one favoured by the customer – and it has to be a dealer to whom you can extend credit, because that's expected of you. Again, it must be a dealer who'll co-operate in selling. There are just a few products I am told – biscuits and whisky – where you can say to a dealer: "All right, I will make you my agent. We'll deliver to you and you go out and sell." But for chemicals etc. on a large scale it is up to the importer to go out and sell the goods. This is one

of several reasons why mutual understanding between buyer and seller – sitting and talking – is so important in Japan. You must always know your customer well, you should know his children's names, but this is ten times as vital in Japan!'

In conclusion, we asked Gordon Kenderdine what advice he would give to a young man beginning his career in the Far East. The first to admit that he himself is not a patient man ('I'm not particularly patient, I often hold myself back: my own instinct is to make up my mind, take a chance and go ahead'), he stresses once again the need for tolerance, for imagination, and for insight into a vastly different code of conduct in business and social life:

'In the East it's very important to discuss things, for hours or days at a time if need be. People get very hurt if something is settled in advance and they didn't know. A quiet approach, a listening approach, a long period of just listening is essential, because the Japanese will not be rushed into a decision. More subtle – and more important – is that however clever you are you're unlikely to have all the facts. In Japan in particular there are reasons never voiced, there are implications. Without close personal contact you will never get at the true reasons. You need imagination, an open mind. Then an understanding of what the Japanese call *GIRI* – the closest translation would be "Obligation." In every action he takes a Japanese is either putting himself under an obligation or putting somebody else under an obligation. Various forms of obligation are extremely important.'

'The Far East was, and to some extent is, an area with no commercial law. In ancient times the traders built up a series of compacts through their trading relationships, through their own clans. There was a very clear pattern of understanding, of give and take within the clans and with other clans. This carries through today, very strongly indeed. If you help a businessman out of a tight spot – say the market has gone against him through no fault of his own – he carries an obligation to repay in some way. He might, for example, sell your products for two years without profit. This *GIRI* is the basis for commercial relationships. Anyone who worked a sharp deal for a short-term gain could not get away with it – he would be a marked man. This relationship of mutual obligation means far more than just not double-crossing a man. It means that all his relationships with you must be smooth, that if you hit a rough patch it must be put right. If you hurt his feelings, as one might well do through being too abrupt by Japanese standards, then one must apologise later, one must take time out for it. . . . It is a social etiquette applicable to business matters.'

'Perhaps it has come more naturally to me because we come from a long line of now fast-disappearing Far-Easterners. I was born in Japan, my father was born in Japan, two of my children were born in Japan, my wife's mother in Peking, my wife in Penang. . . . There is definitely something in this life that attracts, whether it's in Malaya, China, or Japan. In business, even today, there is still something left of the great days, say, of John Company: your responsibilities are much broader, you can pay attention to a much wider range of problems. If you want your responsibilities young, this can still be the place to come and get them.'

# People, projects, products



Mond Division's most unusual vessel, a raft designed to test the endurance of different types of 'Alloprene'-based marine paints in sea water, was launched recently at Caernarvon and towed to a berth in the Menai Strait. It has no bottom and keeps afloat with the aid of buoyancy compartments forming a box-like catamaran shape. Amidships there are racks from which steel plates coated with 'Alloprene'-based marine paints are suspended in the water. 'Alloprene,' the chlorinated rubber ingredient of the paint, was developed by Mond Division and is produced at Pilkington-Sullivan and Lostock Works. Regular checks will be made to see how the plates stand up to the corrosive action of the sea water. Any marine fouling such as barnacles will also be measured. A film unit from the BBC 'Wales Today' programme attended the launching and interviewed Mr. T. F. Birkenhead of the Mond Division's Technical Service Department.

During the three weeks before Christmas Agricultural Division's Plant Protection horticultural station at Fernhurst sent out over 10,000 pots of chrysanthemums, roughly trebling their normal weekly output. Here Mr. Vernon Heath, who is in charge of potted chrysanthemums at Fernhurst, packs plants for Covent Garden market. A strong paper sleeve is slid over each pot and the plants go to market in cartons of six pots, each showing a different colour. It takes about three months from potting the cuttings to marketing the flowers—and production goes on throughout the year, with a normal weekly output of 1200.



Kaleidoscope magic created with mirrors, film and sound track will greet visitors to the Kaleidoscope pavilion at Expo 67, which opens at Montreal in April. The pavilion is jointly sponsored by six Canadian

chemical companies, among them CIL, ICI's Canadian subsidiary. Three exhibition rooms in the building are lined with mirrors, those on the upper walls and ceiling being lightweight plastic mirrors

made from ICI's 'Melinex' polyester film. The exhibition site covers nearly 1000 acres on largely man-made islands in the St. Lawrence River in the heart of Montreal. Some seventy countries are taking

part in this biggest-ever international exhibition which coincides with the centenary of the Confederation of Canada. More than 30 million visitors are expected during the six months the exhibition is open.



## ICI Board changes

Mr. E. J. Callard and Mr. P. T. Menzies have been elected ICI Deputy Chairmen in place of Sir Ronald Holroyd and Mr. L. H. Williams, who both retire at the end of March.

Mr. E. J. Callard, who is 53, joined ICI's engineering staff at Billingham in 1936 from Cambridge, where he took first-class honours in mechanical sciences. During the war he was seconded to the Ministry of Aircraft Production and worked on the manufacture of aviation petrol. Soon after his return to ICI Mr. Callard transferred to the Company's Paints Division, becoming chief engineer there in 1949, a director in 1951, a managing director in 1955 and Division Chairman in 1959. He joined the ICI Board in April 1964. Among other Company appointments he currently holds are the chairmanship of ICI (Europa) Ltd. and a directorship of Imperial Metal Industries Ltd.



Mr. E. J. Callard

A physicist as well as a mathematician, Mr. Menzies spent the first six years of his career in the Inland Revenue and joined the Taxation Section of ICI Treasurer's Department in 1939. He was appointed an assistant treasurer in 1947 and promoted a deputy treasurer five years later. Appointed to the Board in 1956 when he was 43, he took over the duties of Finance Director, a position he has occupied ever since. Since joining the Board he has been invited to become a director of Westminster



Mr. P. T. Menzies

Bank Ltd. and of Commercial Union Assurance Co. Ltd. and is also a part-time member of the Central Electricity Generating Board. Mr. Menzies is also Chairman of Imperial Metal Industries Ltd., the ICI subsidiary which controls the Company's metals interests, and Deputy Chairman of Yorkshire Imperial Metals Ltd.

The third Board appointment is that of Mr. T. B. Clark, Chairman of HOC Division, as an ICI Director. A Scot, Mr. Clark graduated



Mr. T. B. Clark

from St. Andrews with first-class honours in chemistry and joined ICI as a research chemist in 1934. After wartime service with the Royal Artillery, during which he was mentioned in despatches, he returned to ICI to the then Head Office Development Department, subsequently moving to the sales organisation when he became sales control manager for organic sales in 1954. Four years later he was appointed to the Board of the new HOC Division, becoming its Chairman in 1964.

## New Division Chairmen

Mr. J. A. Lofthouse, a Deputy Chairman of HOC Division, has been appointed to succeed Mr. Clark on his appointment to the ICI Board, and Mr. R. G. Hoare, a Deputy Chairman of Pharmaceuticals Division, will succeed Mr. S. Howard as Division Chairman on his retirement at the end of next month.

Mr. J. A. Lofthouse joined the then ICI Fertilizer and Synthetic Products Group in 1939 after graduating from Cambridge with honours in mathematics and mechanical sciences. Following war-

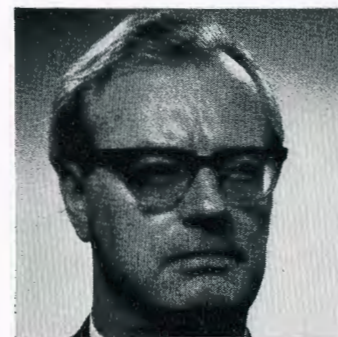


Mr. J. A. Lofthouse

time service with the Special Weapons Section, he gained wide experience of research and in the design and maintenance of am-

monia, fertilizer and petrochemical plants, being appointed the first engineering manager of the Heavy Organic Chemicals Division on its formation in 1958. He became a Deputy Chairman of the Division in 1966. In 1965 Mr. Lofthouse was invited to join the Economic Development Committee for the civil engineering industry.

Mr. R. G. Hoare joined ICI (China) Ltd. in 1946 as an assistant in that company's pharmaceuticals department, of which he became the head two years later. In 1953 he was appointed assistant overseas sales manager of IC (Pharmaceuticals), which later became



Mr. R. G. Hoare

the Pharmaceuticals Division. He was appointed to the Division Board in 1958, becoming a Deputy Chairman in 1965.

## Millionth ton of 'Alkathene'

The millionth ton of 'Alkathene,' the ICI brand of polythene, was dispatched from Wilton Works on 21st December. Mr. N. L. Dawson, assistant distribution officer (right) hands delivery instructions to the driver. An ICI invention, polythene was discovered in the laboratories of Alkali Division in

1933, but owing to the enormous problems connected with the very high pressures needed in the production, full-scale manufacture was not possible for several years. The first full-scale plant, at Wallerscote in Cheshire, actually started production on 1st September 1939, the day the Germans invaded Poland—an odd coincidence, because this material was later used to supply the exacting



needs of insulation for airborne radar, one of the decisive war weapons invented by the British. Manufacture at Wilton Works was begun in 1951 and responsibility for polythene was transferred to Plastics Division in 1958. Now a household word, 'Alkathene' is used everywhere from transatlantic telephone cables to the colourful washing-up bowls seen in almost every home.

## New Year honours

Two Mond Division men were honoured by the Queen in the New Year Honours List. They are former Drawing Office Services Manager Mr. Tom Stringer, who retired at the end of November and who receives the MBE, and Mr. Jack Morgan, an electrician and shop steward at Bain Works, Wilton, awarded the BEM.



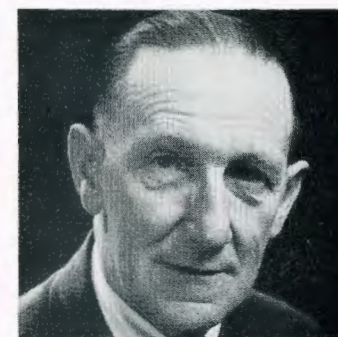
Mr. T. Stringer

Mr. Stringer, who had completed 46 years' service with the Company when he retired, became widely known in the Division as prime mover and first chairman of the Division Engineering Department Social and Recreational Committee. He was also chairman for many years of the then General Chemicals Swimming Section and

chairman of the Horticultural Section. He represented ICI on a panel of the Engineering Equipment Users' Association from 1962 to 1964, and as chairman of the Apprentice Training Panel until his retirement he was closely concerned with apprentice selec-

tion and training. Mr. Stringer is honorary architect and vice-chairman of the new Runcorn Boys' Club.

Mr. Morgan, well known as a Bain Works shop steward and former Works and Central Councillor, is a member of the Guisborough Urban District Council. He was chairman five years ago and was elected to the North Riding County Council in 1962. He is also chairman of North Riding District Councils' Association and of the Guisborough Arts Association. Among other bodies on which he serves are the Boards of Governors of the Guisborough Grammar and Secondary Modern Schools, the Board of Managers of the Guisborough Group of Primary Schools, and the local



Mr. J. Morgan

Co-op Management Committee, of which he has been a member for 24 years.

Another award of interest to readers is the Honorary CBE to Mr. Arthur Edbrooke, President of Duperial Argentina, last November.

## ICI forms new American Subsidiary

A new subsidiary, ICI America Inc., has been formed to bring together a number of ICI's interests in the United States. This new company will operate through three existing subsidiaries, ICI (New York) Inc., ICI Organics Inc., and Chemical Manufacturing Co.

The main functions of ICI (New York) Inc. are general liaison, sales promotion and purchasing in the United States on behalf of the ICI Group. Chemical Manufacturing Co. has for many years sold a wide range of products of the ICI Group in the USA. ICI Organics Inc., whose head office is at Providence, Rhode Island, makes and sells dyestuffs and pigments, textile auxiliaries, pharmaceuticals and chlorine derivatives. Its main plants are at Dighton, Massachusetts, and Bayonne, New Jersey. All three companies will continue, for the time being, to operate as separate entities. ICI's other interests in the United States are unaffected.

The President of ICI America is forty-four-year-old Mr. William Duncan, formerly ICI General Manager, Management Services, and the offices of the Company are at 444 Madison Avenue, New York City, where ICI (New York) are also based.

## More British purse-seiners in 1967

Purse-seine nets, first used by British fishing vessels last year, are likely to be introduced more extensively following initial successes. During 1967 it is thought that at least another six vessels will be using these vast nets for catching herring.

Made from nylon, a single purse seine is big enough to cover five full-size football pitches or to completely swallow up St. Paul's Cathedral. Fully rigged, it may weigh five tons or more. It is worth about £10,000. One of the first British vessels to be equipped for purse-seining is the *Glenugie III*, a 78 ft. converted herring drifter. She works in partnership with *Lunar Bow*, which plays the second boat. In one week recently the pair landed 1300 crans of herring, about 680 crans of which were taken in a single night.

*Glenugie III* has been using her purse seine since June last year. Manufactured by Bridport-Gundry Ltd., Europe's biggest netmakers, it measures 240 fathoms by 70 fathoms and contains about 7000 lb. of ICI nylon and is rigged with two-and-a-half miles of 'Terylene' rope. The net gives *Glenugie III* a catching power equivalent to about ten conventional drifters.

## ICI sponsors 'Perspex' design exhibition

Signs, sculpture, lighting fittings and jewellery designed in 'Perspex' by students of the Royal College of Art will be shown in London next May. The exhibition, 'Prospex '67—The Royal College of Art looks at 'Perspex'', is being sponsored by ICI and will be held at the College (Kensington Gore, S.W.7) from 13th May to 2nd June. Plastics Division has supplied the material and has provided technical advice to enable students in most departments of the College to experiment with 'Perspex' as part of their studies during 1966/67. By giving young art students this opportunity to explore 'Perspex' as an artistic medium the Division hopes to create new interest in the design potential of this material and to raise the standard of design for existing applications.

## Mr. H. N. Wilson

One of the Company's most distinguished analytical chemists, Mr. H. N. Wilson, died suddenly at his home in Stokesley, Yorkshire, on 15th October. H. N. Wilson was joint editor with C. R. N. Strouts and R. T. Parry-Jones of the three-volume work entitled *Analytical Chemistry—The Working*

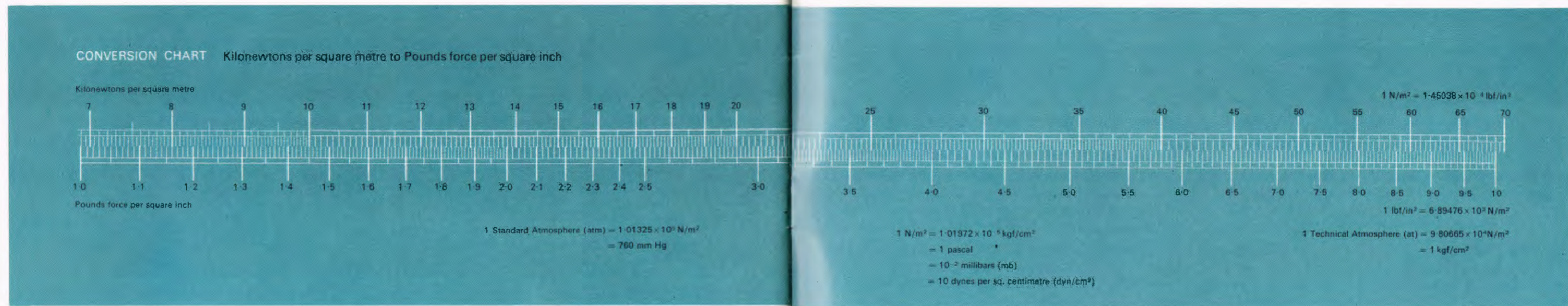
*Tools* compiled by the ICI Analytical Chemists' Committee. Since his retirement in 1962 he had been retained as a consultant by the Agricultural Division, and he also found time to write a book, *An Approach to Chemical Analysis*, which was conceived as a book on chemical analysis 'as it is' rather than 'as it should be.' As a fitting climax to a distinguished career he became last year the first recipient of the Society for Analytical Chemistry's new Gold Medal Award for distinguished work in this field. He was always an active man and at the time of his death had just finished a review of industrial gas analysis soon to be published.

## Try Winsford!

The *Guardian* recently carried a story in its 'Miscellany' column about a textile engineer from Macclesfield just returned from Siberia, where he had been installing some machinery. At the end of his stint he asked a Russian trade official if he could see a salt mine. Next day the official returned with the following suggestion: 'We don't seem to have any salt mines around here, but when you get home why not try Winsford? There is one there only 30 kilometres from Macclesfield.' The *Guardian's* headline: 'Mine of Information.'

# WHAT IS METRICATION?

E. W. Greensmith and A. Parrish



Metriation is something which will affect – some might say afflict – all of us quite soon.

Most of us know that in 1971 we shall change from our present monetary system of pounds, shillings and pence to a decimal system. This decimal system will probably be based on the £, divided into 100 pence. Those who have travelled abroad know how convenient a decimal currency can be and how quickly they cease to fear what a British statesman (Lord Randolph Churchill) once described as ‘those damned dots.’

First advocated by a Royal Commission as long ago as 1841, this change will take effect virtually overnight in February 1971. Well before then, new coins will have to be designed and minted, while existing business machines will have to be modified or replaced. Announcing this change in March 1966 the Chancellor of the Exchequer said that a preliminary estimate of the cost was £120 million.

Metriation is a similar change in our weights and measures and will be even more difficult than the currency change. This was recognised by the President of the Board of Trade when he announced the Government’s decision in May 1965. ‘The Government,’ he told the House of Commons, ‘are impressed with the case put to them by the representatives of industry for the wider use in British industry of the metric system of weights and measures. Countries using that system now take more than one-half of our exports, and the total proportion of world trade conducted in terms of metric units would no doubt continue to increase. Against that background the Government consider it desirable that British industries on a broadening front should adopt metric units sector by sector, until that system can become in time the primary system of weights and measures for the country as a whole.’

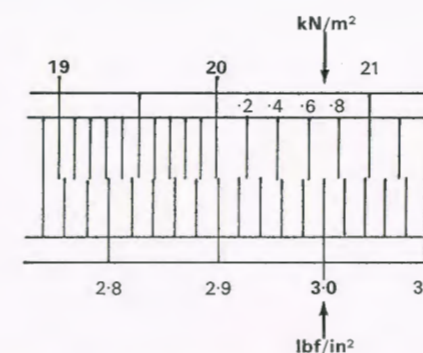
‘Practical difficulties attending the change-over will, of

course, mean that this process must be gradual, but the Government hopes that within ten years the greater part of the country’s industry will have made the change.’

It is important to note the reference to ‘industry on a broadening front . . . sector by sector,’ and to the process being gradual. While there are those who think the changes should be made at one fell swoop, many – and perhaps most housewives – will be glad to know that early last year the President of the Board of Trade said in the House, ‘I think that it would be very difficult to introduce decimalisation in this field at the same time as we introduced decimal currency. The effect on our traders of having to deal with both at the same time, and the effect on customers, would be rather formidable. I think it would have one positive result – it would increase the sale of headache powders.’

We can therefore assume that we shall change to the new currency in 1971, we shall change gradually over to metric units as our primary system of weights and measures in industry, and only later shall we do our retail shopping in kilogrammes instead of pounds, metres instead of yards, and litres instead of pints.

A decimal system of units was conceived as early as the 16th century, but the practical adoption of the idea had to wait for the general increase in administrative activity which followed the French Revolution. This system was based on the metre as the unit of length and the gramme as the unit quantity of matter. Although introduced primarily to benefit industry and commerce, the metric system was quickly taken up in scientific and technical circles. Since 1875 all international matters concerning the metric system have been the responsibility of the *Conférence Générale des Poids et Mesures* – an international conference which is usually held every



The logarithmic scales are similar to those on an ordinary slide rule but are positioned to give direct readings without the need for repeated settings. All values are obtainable within slide rule accuracy by using multiples and sub-multiples of 10.

**Example:** To convert 3 lbf./in.<sup>2</sup> to kN./m.<sup>2</sup> read 3 lbf./in.<sup>2</sup> on the bottom scale and the value opposite on the top scale, i.e. 20.68 is the equivalent in kN./m.<sup>2</sup>. The intermediate scale readings which are not numbered are estimated as with an ordinary rule. Similarly 30 lbf./in.<sup>2</sup> is obtained from the 3 mark on the lower scale, the upper scale reading is multiplied by 10 and equals 206.8

sixth year in Paris: the UK makes its own contribution to this work through the Board of Trade.

The original system has changed, so that there are now three metric systems: the centimetre-gramme-second system (c.g.s.); the metre-kilogramme-second-ampere system (MKSA); and the *Système International d’Unités* (SI); discussions are now going on within the International Organisation for Standardization (ISO) to decide whether the SI can be used exclusively in future by all the nations who are using or will use metric measurements. This system has not so far been

used to any extent by industry and commerce either in the UK or overseas, but present indications suggest that SI will be generally adopted, so that many of us will need to become familiar with it. The details are too involved to explain in this short article and those who are still with us and who want to know about SI are advised to study the excellent little booklet issued by the British Standards Institution ‘The Use of SI Units.’ The BSI conversion chart indicates the sort of derived units such as Newtons per square metre to which we shall have to become accustomed. It was copied from an original design by the Indian Standards Institution and covers conversions of the principal units in the inch and metric systems. Interpolation is, however, necessary to obtain many intermediate values.

It is doubtful if many readers will recognise 940, 610, 915, but it is equally doubtful if anyone would fail to get an immediate – and interesting – impression if these three dimensions are converted from millimetres to the nearest whole number of inches – try for yourself (divide each by 25.4).

The International System (SI) is a coherent system with six basic units, as set out below:

Quantity	Name
length	metre
mass	kilogramme
time	second
electric current	ampere
thermodynamic temperature	degree Kelvin
luminous intensity	candela

In addition, there are some derived units to which special names have been given, some of which are completely new; and others again have called for complex rather than simple names. Of particular interest to British people for example, is the NEWTON, a unit of force. The official definition of a NEWTON is: 'that force which, when applied to a body having a mass of one kilogramme, gives it an acceleration of one metre per second squared.' This unit also appears in the derived units of pressure and stress which in 'pure' SI units is the Newton per square metre. This is inconveniently small for practical purposes –  $1 \text{ N/m}^2 = 0.000145038 \text{ lbf/in}^2$  – but in practice multiples will be used such as  $\text{kN/m}^2$  or  $\text{MN/m}^2$ . The former is about 1/100 of an atmosphere and the latter about 10 atmospheres. Agreement is also being sought to the use of smaller derived units of area, such as the square millimetre so that for instance the unit  $\text{N/mm}^2$  can be used in place of  $\text{MN/m}^2$ , both being of the same magnitude. Other cases are being considered where multiple units outside the pure SI are needed.

## Considerations involved

Why did the Government decide to announce this change and how has the Company been involved? At the end of 1958 a questionnaire was sent out by the British Association for the Advancement of Science which had appointed a committee to investigate the costs and implications of adopting the metric system in Britain. Comments based on a Company-wide investigation were submitted by ICI to the Association at that time. Four years or so later the British Standards Institution published a reasoned appreciation of the considerations involved, including a tentative programme for a phased change-over to the metric system extending over a notional period of some 20 years. It also pointed out the need for parallel moves in education, industry and commerce. In February 1965 the then FBI (now the Confederation of British Industry) found that a majority in British industry favoured the adoption of the metric system as the primary system of mensuration as soon as this could be achieved by general agreement. This majority included the chemical industry and most, though not all, of the engineering industry. In May 1965 the President of the Board of Trade made the announcement from which we quoted earlier, and in February 1966 the Minister of Technology set up a small standing joint committee of representatives of Government Departments and industry 'to encourage, assist, and review the progressive adoption within British industry of the metric system of weights and measures.'

Since the change is bound to alter the size of many of the unit quantities we use, we shall have to start learning to think in SI units and above all to base our design concepts upon them. For example: it is possible to convert 1 gallon to its metric equivalent (0.00456 cubic metres or possibly 4.546 litres) or 1 inch to 25.4 millimetres, but these are awkward

quantities for day-to-day use. In many processes we in ICI are already practically 'bi-numeral,' but for most engineering plant and equipment we still think in inch-pound units.

Now much of our plant and of engineering equipment in the country generally will be in use for years after we have officially 'gone metric' for new designs. We shall therefore have to work with both systems during that period, but gradually the old 'inch' plants will be replaced by new equipment designed on the basis of SI units – and designed increasingly by new generations of engineers who have been taught to think in these terms. No one can foresee how long this transitional period will last but we can be reasonably sure that it will extend beyond the working lives of most of us now in the Company. Indeed, some of us may not see – as employees – the first ICI plant in the UK designed in SI units.

Although we know the change is coming, it would be wrong for the Company to take unilateral action, because we might thereby adopt practices incompatible with national and international agreements now being prepared. We are, however, collaborating with the Ministry of Technology, the CBI and other organisations in planning for the changes and with the British Standards Institution in preparing the necessary standards to enable us to make the changes effectively at the appropriate times. One contribution already made by the Company is the creation of the ICI conversion scales shown on pages 32–33.

Each scale relates to selected units in common use and enables all values to be read within slide rule accuracy. Similar information can be derived by using a slide rule but this involves repeated settings which are eliminated by the ICI conversion scales. The scales were devised by Mr. A. Parrish of Engineering Services Department.

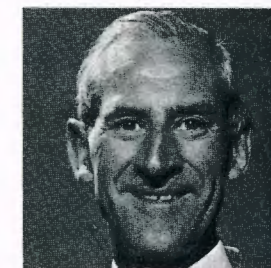
In the chemical industry we shall have to consider the changes under three headings: raw materials, finished products, and the plant which converts the first into the second. To a considerable extent the Company already uses both inch and metric systems in dealing with raw materials and with finished products, so that some of the problems are well understood.

Some other sections of British industry also work with both systems of measurement, but the majority – probably a large majority – will have to start practically from scratch. Most of ICI's plant and equipment is bought from outside suppliers, and they, like us, will have to convert their designs and the measuring equipment and machine tools they use in meeting our orders. Even when confined to essentials, such changes will be complex and costly. To get the full benefit from the long-term advantages to be expected from this radical change, we in Britain must take this unique opportunity to rationalise our practices and to eliminate unnecessary variants from the ranges of things we make and use. We must base our British standards on the simplest possible range needed to compete effectively in international trade.

# People in print



**Graham Hutton** is the author of many books on economics and international problems and contributes to leading British and foreign publications. Educated at Christ's Hospital and at British, French and German universities, he also qualified as a Barrister. After obtaining a 1st class honours degree in Economics, he became a research Fellow and tutor at the London School of Economics. He was assistant editor of the *Economist* from 1933 to 1938, worked at the Foreign Office and Ministry of Information from 1939 to 1945, and since 1946 has been an economic consultant.



**Peter Chivers** has been works medical officer of Mond Division, Winnington, since he joined ICI in 1953. After qualifying at Manchester University in 1946, he did several hospital jobs and then became a 'Saturday afternoon sailor' in the Merchant and Royal Navy for four years. He followed this up with a two-year apprenticeship in industrial medicine with the British Motor Corporation. Dr. Chivers dislikes lecturing on first aid but he enjoys the 'stage-managing' side of competitions. His hobbies are photography, Rotary Club activities and making – and consuming – beer.



**Margaret Reekie** is press officer of ICI Fibres Ltd. She joined British Nylon Spinners as their press officer in 1946 and came to ICI when BNS was merged with Fibres Division in 1965. An Oxford graduate, she began her career as a journalist. During the war she worked for the Ministry of Information and in the public relations department of the Board of Trade.



**John Wren-Lewis** is a member of Head Office Research and Development Department. On graduating in mathematics from Imperial College, London, in 1944, he joined a research team associated with ICI doing special wartime research and has been with the Company ever since. A rare combination of scientist and theologian, he has become well known as a writer and broadcaster.



**Edward Greensmith** has been head of Engineering Services Department at Head Office since 1952 and engineering adviser to the ICI Board since October 1964. He joined the Research Department of the then Alkali Division in 1937 and came to Head Office in 1948 as Chief Inspecting Engineer. He is a member of the 'little Neddy' on Mechanical Engineering and in March 1966 accepted an invitation from the Minister of Technology to become a member of the Standing Joint Committee on metrication.



**Albert Parrish** is head of the ICI Standards Section. He joined the then Synthetic Ammonia and Nitrates as a draughtsman in 1927 and after the formation of ICI worked with Sir Ewart Smith on engineering standardisation. During the war he was seconded to the Royal Ordnance filling factories to organise standards under Lord Hinton. He is active in the work of the British Standards Institution and is a delegate to the International Standards Organisation.

ICI Magazine is published for employees every other month, price 4d. Articles, photographs, and suggestions for articles are invited from members of the Company. Payment is made for those accepted. The Company does not necessarily endorse the views expressed by contributors.

# ICI

magazine

The new smooth look in 'Crimplene' jersey.  
Cube patterned trouser suit by Harvey Gould

